SECTION 16120

BUILDING WIRE AND CABLE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Building wire and cable.

B. Wire and cable connectors

C. Insulating tape and tubing

1.2 REGULATORY REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70 - *National Electrical Code*.

B. Furnish products listed and classified by Underwriters Laboratories, Inc., as suitable for purposes specified and shown.

1.3 PROJECT CONDITIONS

A. Verify that field measurements are as shown on Drawings.

B. Wire and cable routing shown on Drawings is approximate unless dimensioned. Route wire and cable as required to meet project conditions.

C. Where wire and cable routing is not shown, and destination only is indicated, determine exact routing and lengths required to meet project conditions.

PART 2 PRODUCTS

2.1 BUILDING WIRE AND CABLE

A. Provide UL listed building wire and cable as shown on the Drawings with the following characteristics:

1. Description: Single conductor insulated wire.

2. Conductor: 98% conductivity, annealed, uncoated copper.

3. Conductor stranding:

a. Power conductors, No. 10 AWG and smaller, solid.

b. Control conductors, No. 10 AWG and smaller, stranded.

c. Conductors No. 8 AWG and larger, stranded.

4. Insulation: The following types, rated 600 volts:

a. No. 2 AWG and smaller, Type THHN/THWN per UL Standard 83—*Thermoplastic Insulated Wires.*

b. No. 1 AWG and larger, Type THHN/THWN per UL Standard 83 or Type XHHW per UL Standard 44—*Rubber Insulated Wires and Cables.*

****
Edit 5 to match Project requirements.
****

5. Refer to Section 16721, FIRE ALARM SYSTEM for fire alarm system conductor requirements.

B. Color code conductors as follows:

1. Use colored insulation for color coding conductors No. 6 AWG and smaller.

2. Use water and oil resistant colored plastic adhesive tape, 3/4 inch minimum width, for color coding conductor No. 4 AWG and larger. Manufacturer: 3M “Scotch 35"

3. Provide black conductor insulation where colored tape is used for color coding.

4. Use the following color codes for AC power system conductors:

	208Y/120V System	480Y/277V System
Phase A:	Black	Brown
Phase B:	Red	Orange
Phase C:	Blue	Yellow
Neutral:	White	White/Orange
Equipment Ground:	Green	Green
Isolated Ground:	Green/Yellow	Green/Yellow

5. Use the following color codes for DC power system conductors:

Positive: Red
Negative: Black

****
Edit 6 to match Project requirements.
****

6. In existing facilities, change color coding of existing service, feeder, and major branch circuits (50 amps and larger) to match the above color code.

****
Edit 7 to match Project requirements.
****

7. Refer to Section 16721, FIRE ALARM SYSTEM for fire alarm system color code.

8. Provide color code for control conductors as indicated on equipment or control system manufacturer’s drawings.

2.2 WIRING CONNECTORS

A. Provide solderless insulated, spring type connectors, rated 600 volts and 105 ºC for splices and taps for wire sizes No. 8 AWG and smaller. Manufacturer: 3M “Scotchlock”

B. Provide tin-plated copper, mechanical type connectors that meet the requirements in UL Std. 486A for splices and taps for wire sizes No. 6 through No. 2 AWG. Manufacturer: Burndy “SERVIT”

C. Provide circumferential compression connectors that meet the requirements in UL Std. 486A

for wire sizes No. 1 AWG and larger. Lugs, splices, reducer adapters and tap connectors shall be manufactured from electro-tin plated seamless copper tubing and marked with cable accommodation, die codes and crimp locations. Manufacturer: Burndy “HYLUG”, “HYLINK”, and “HYTEE”

D. Provide crimp-on, nylon insulated, insulation grip, brazed seam terminals for control wiring as follows:

1. Use ring tongue terminals for nutted studs. Manufacturer: Burndy “Type TN”

2. Use flanged fork terminals for barrier terminal strips. Manufacturer: Burndy “type YAE-Z”

3. Use pin terminals for DIN type terminal blocks. Manufacturer: 3M type “MNG-P”.

2.3 INSULATING TAPE AND TUBING

A. Provide vinyl plastic tape that meets the requirements of UL 510 and has the following characteristics:

1. 7 mil minimum thickness

2. Rated 600 volts and 105 ºC, suitable for indoor and outdoor applications,

3. Retains flexibility, adhesion, and applicable at temperature ranges from 0 through 100 ºF without loss of physical or electrical properties,

4. Resistant to abrasion, moisture, alkalies, acid, corrosion, and sunlight.

5. Manufacturer: 3M “Scotch Super 33+”

B. Provide heat shrinkable tubing that meets the requirements of UL 486D and has the following characteristics:

1. Rated 1kV

2. Factory applied adhesive/sealant

3. Flame retardant to IEEE 383, *Vertical Tray Flame Test*

4. Manufacturer: Raychem “FCSM”

2.4 WIRE PULLING LUBRICANT

A. Provide wire pulling lubricant that is compatible with conductor insulation, has a maximum coefficient of friction of 0.055, and is stable up to a temperature of 180 ºF. For cold weather installations, provide wire pulling lubricant suitable for conduit temperature.

B. Manufacturer: IDEAL “Yellow 190" or “Aqua-Gel CW”

PART 3 EXECUTION

3.1 PREPARATION

A. Examine raceways and building finishes to receive wires and cables for compliance with installation tolerances and other conditions. Do not proceed with installation until

unsatisfactory conditions have been corrected.

****
Edit B to match Project requirements.
****

B. Remove existing wire from raceways before pulling in new wire and cable.

C. Completely and thoroughly swab raceways before installing wire.

D. Store cable for 24 hours in the installation area ambient temperature before installing.

3.2 INSTALLATION

A. Install products following manufacturer's instructions.

B. Use solid conductor for power circuits No. 10 AWG and smaller except use stranded conductors in flexible conduits.

C. Use stranded conductors for power circuits No. 8 AWG and larger.

D. Use stranded conductors for control circuits.

E. Use conductors not smaller than No. 12 AWG for power and lighting circuits.

F. Use conductors not smaller than No. 14 AWG for 120V control circuits.

G. Use conductors not smaller than No. 16 AWG for 24V control circuits.

H. Use No. 10 AWG conductors from panelboard to first outlet for 20 ampere, 120 volt branch circuits longer than 75 feet.

I. Use No. 10 AWG conductors from panelboard to first outlet for 20 ampere, 277 volt branch circuits longer than 150 feet.

J. Pull all conductors into a raceway at same time.

K. Do not "through-pull" conductors at boxes, fittings or cabinets where a change of raceway alignment occurs.

L. Use suitable wire pulling lubricant for installing building wire in raceways.

M. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage cables or raceway.

N. Neatly train and lace wiring inside boxes, equipment, and panelboards.

O. Install wiring at outlets with at least 6 inches of slack conductor at each outlet.

P. Clean conductor surfaces before installing lugs and connectors.

Q. Do not cut conductor strands to fit into connectors.

R. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.

S. Terminate conductors No. 1 AWG and larger using compression connectors at the following locations: install using manufacturer’s recommended compression tools and dies:

1. Circuit breakers larger than 100 amperes; at smaller circuit breakers use mechanical lugs.

2. Safety switches larger than 100 amperes; at smaller safety switches use mechanical lugs.

3. Transformers.

4. Switchgear, switchboard, panelboard, busway and motor control center main lugs.

T. Terminate control conductors using crimp-on terminals.

U. Connect outlets and components to wiring and to ground as indicated and instructed by manufacturer. Tighten connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque-tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals according to tightening torques specified in UL Standard 486A.

V. Insulate splices and taps of irregular shapes with manufactured insulating covers or vinyl tape built up to not less than the conductor insulation thickness.

W. Insulate cylinder shaped splices and taps, connector barrels and adapter barrels using heat shrinkable insulating tubing or insulating covers manufactured for the connector.

X. Apply color coding tape on conductors at each termination, splice, junction and pull box.

Y. Post conductor color code on each panelboard, switchboard, switchgear assembly, motor control center, dry-type transformer, safety switch and separate motor controller. Use type-written, adhesive-backed labels

3.3 INTERFACE WITH OTHER PRODUCTS

A. Identify wire and cable under provisions of Section 16195, ELECTRICAL IDENTIFICATION.

B. Identify each conductor with its circuit number or other designation indicated on Drawings.

3.4 FIELD QUALITY CONTROL

A Upon installation of wires and cables and before electrical circuitry is energized, show product capability and compliance with requirements.

B. Perform the following visual and mechanical inspections in accordance with procedures in NETAATS-1991.:

1. Inspect wire for physical damage and proper connection according to the Drawings.

2. Measure tightness of mechanical connections and compare torque measurements with manufacturer's recommended values. Use a calibrated torque wrench.

3. Check for correct conductor color coding according to Specifications.

C. Perform the following electrical tests:

1. Test insulation resistance of each conductor with respect to ground and other conductors in the same raceway. Use a 1000Vdc megger; maintain test for 1 minute on each conductor.

2. Test continuity of each power circuit conductor.

3. Test continuity of each control circuit conductor.

4. Evaluate test results by comparison with conductors of the same length, size and insulation type. Investigate any values less than 50 megohms.

D. Correct malfunctioning products at the site, where possible, and retest to prove compliance; otherwise, remove and replace with new units, and retest.

END OF SECTION